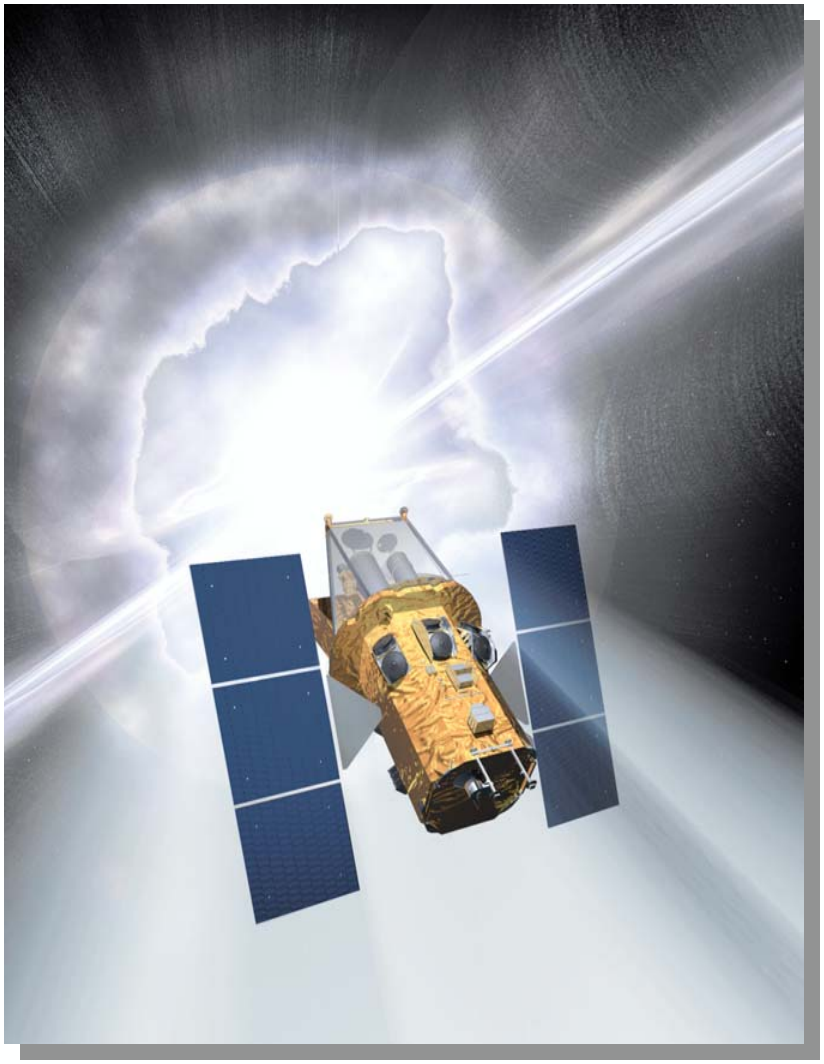
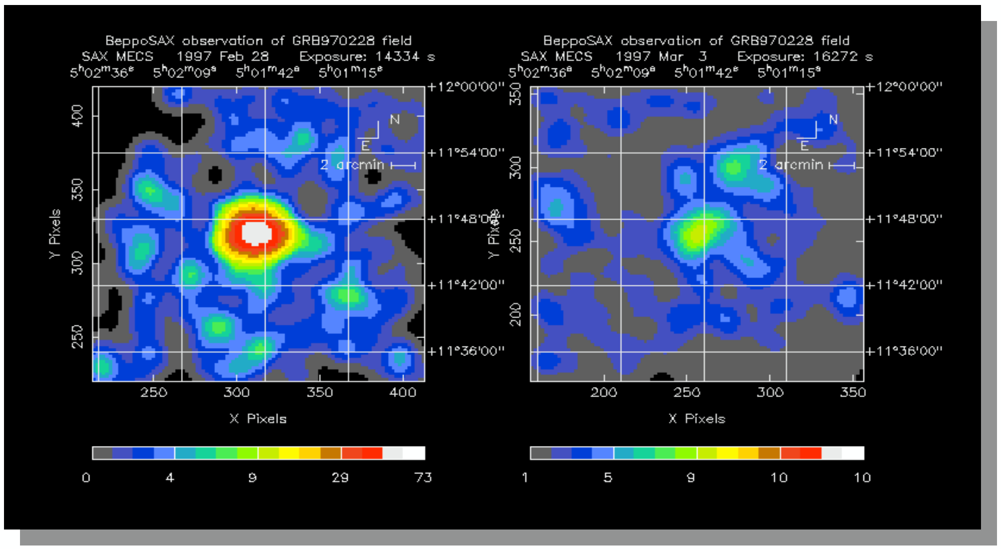


Swift Capabilities Relevant to GLAST

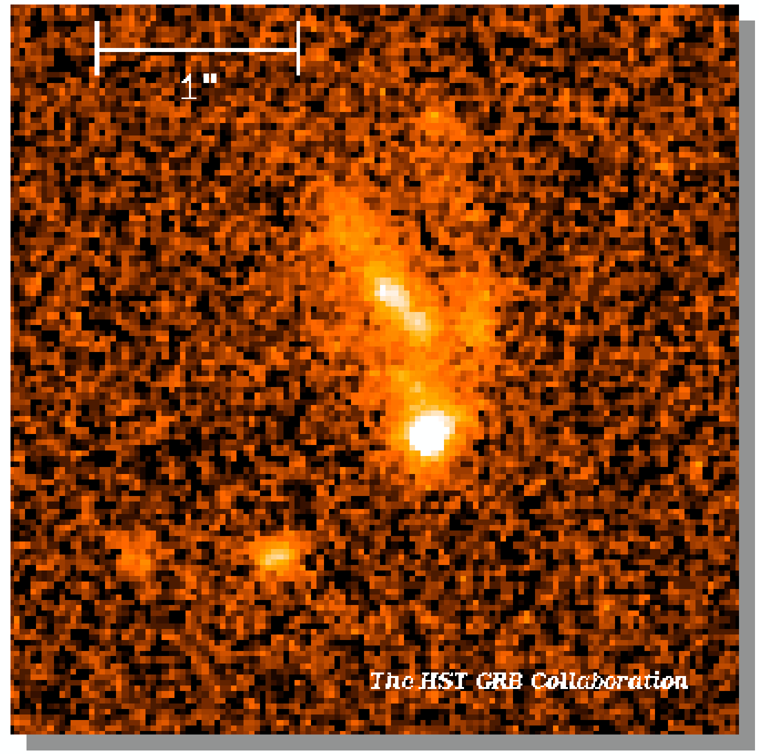
Neil Gehrels

Motivations for Swift

BeppoSAX X-rays



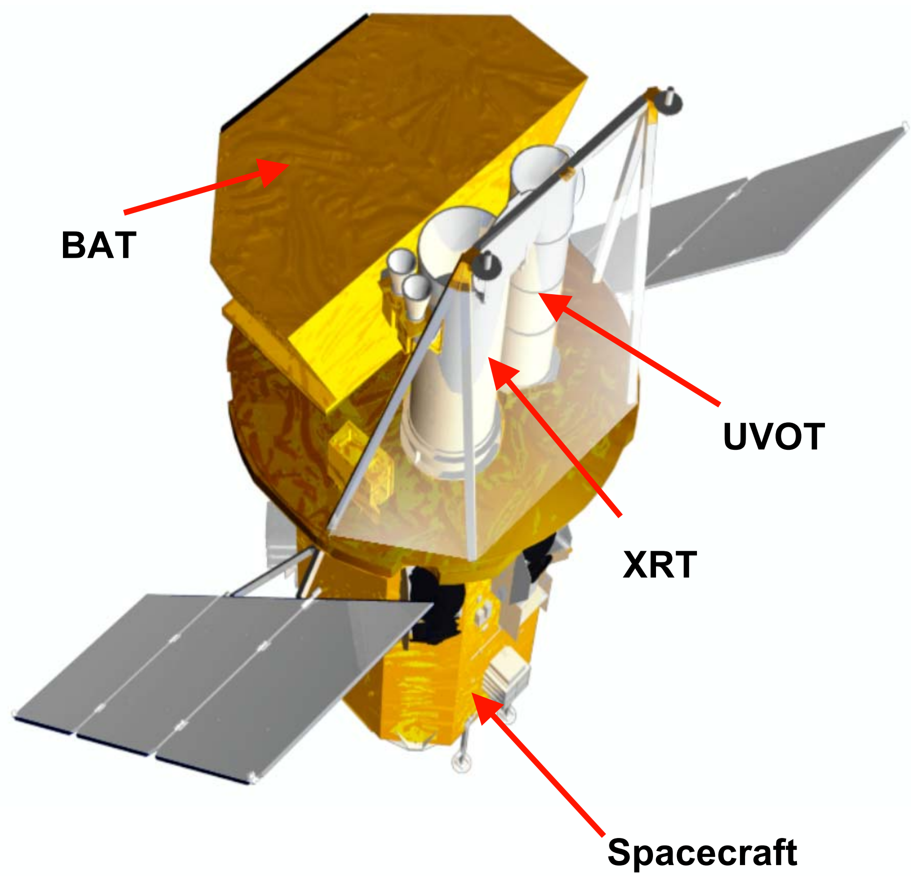
HST Optical



Swift Instruments

Instruments

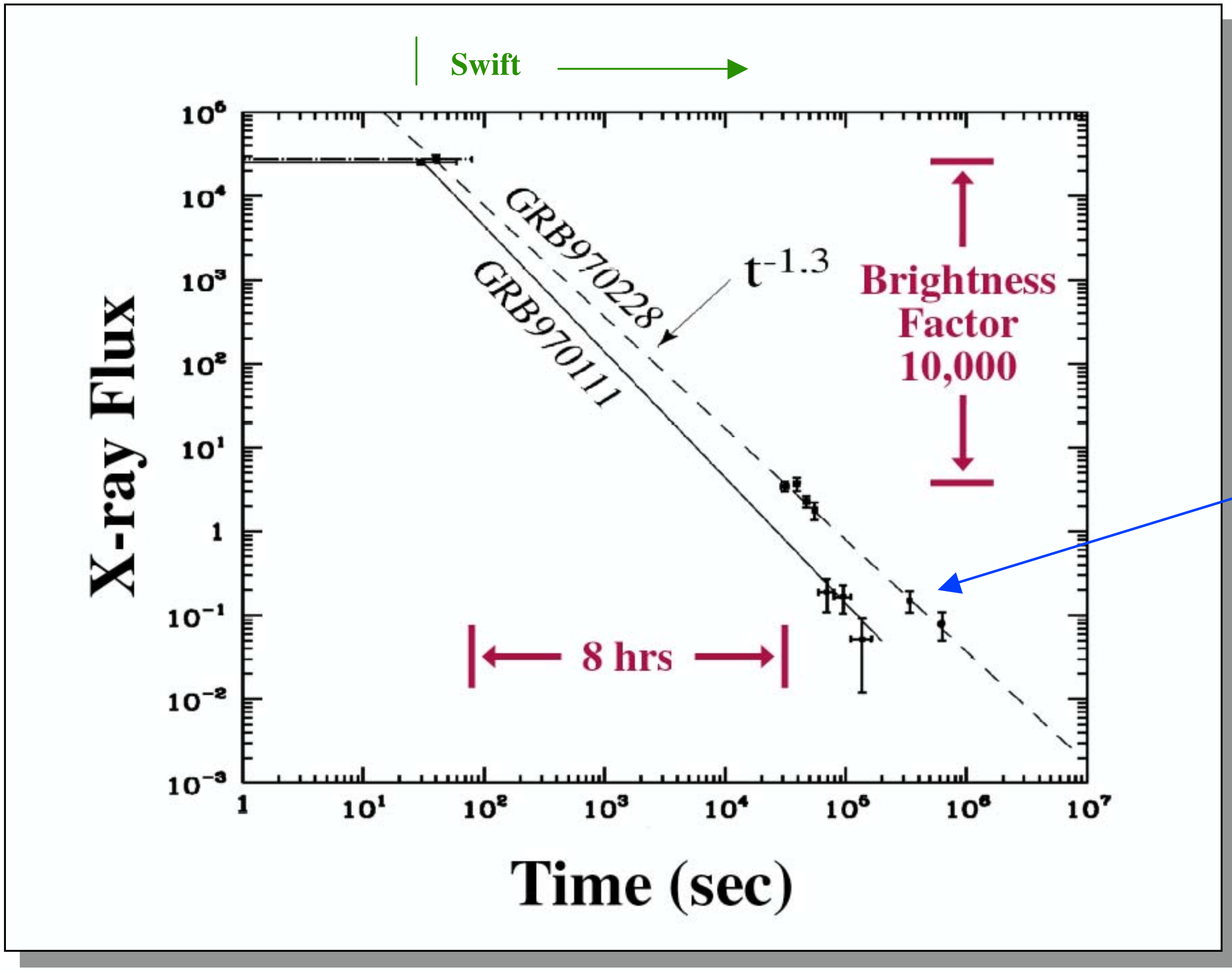
- Burst Alert Telescope (BAT)
  - New CdZnTe detectors
  - Detect >100 GRBs per year depending on logN-logS
  - Most sensitive gamma-ray imager ever
- X-Ray Telescope (XRT)
  - Arcsecond GRB positions
  - CCD spectroscopy
- UV/Optical Telescope (UVOT)
  - Sub-arcsec imaging
  - Grism spectroscopy
  - 24^{th} mag sensitivity (1000 sec)
  - Finding chart for other observers



Spacecraft

- Autonomous re-pointing, 20 - 70 sec
- Onboard and ground triggers

The Gap



Swift
10^5
10^4
10^3
10^2
10^1
1
10^{-1}
10^{-2}
10^{-3}
1
10^1
10^2
10^3
10^4
10^5
10^6
10^7
X-ray Flux
Time (sec)
GRB970228
GRB970111
$t^{-1.3}$
Brightness
Factor
10,000
8 hrs
Beppo SAX
data

Swift Team

OSSERVATORIO ASTRONOMICO DI BRERA

NASA

GSFC

PENNSTATE

1855

University of Leicester

UCL MSSL

eV PRODUCTS

asi agenzia spaziale italiana

SwRI

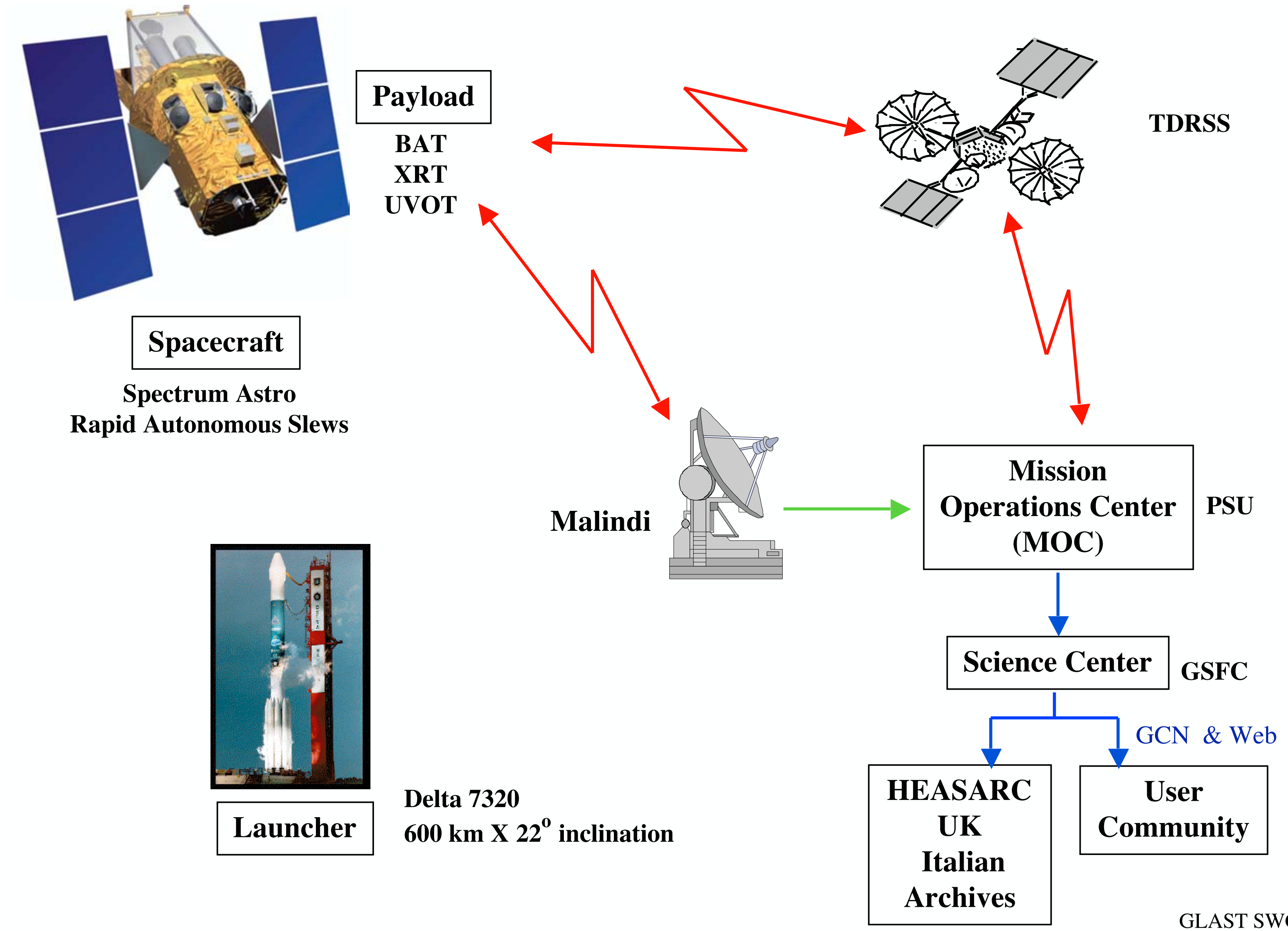
SPECTRUMASTRO

SWALES AEROSPACE

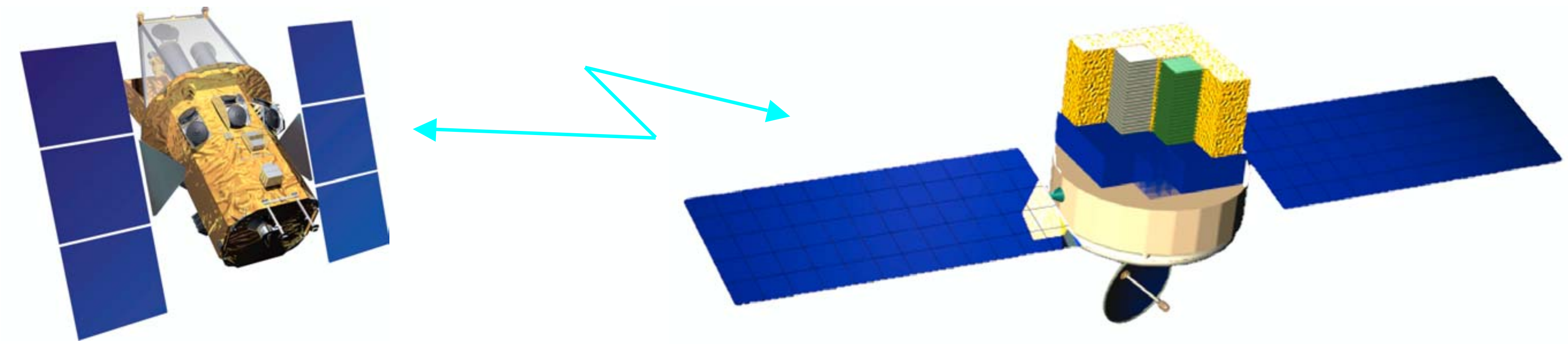
OMITRON inc.

Los Alamos NATIONAL LABORATORY

Swift Mission



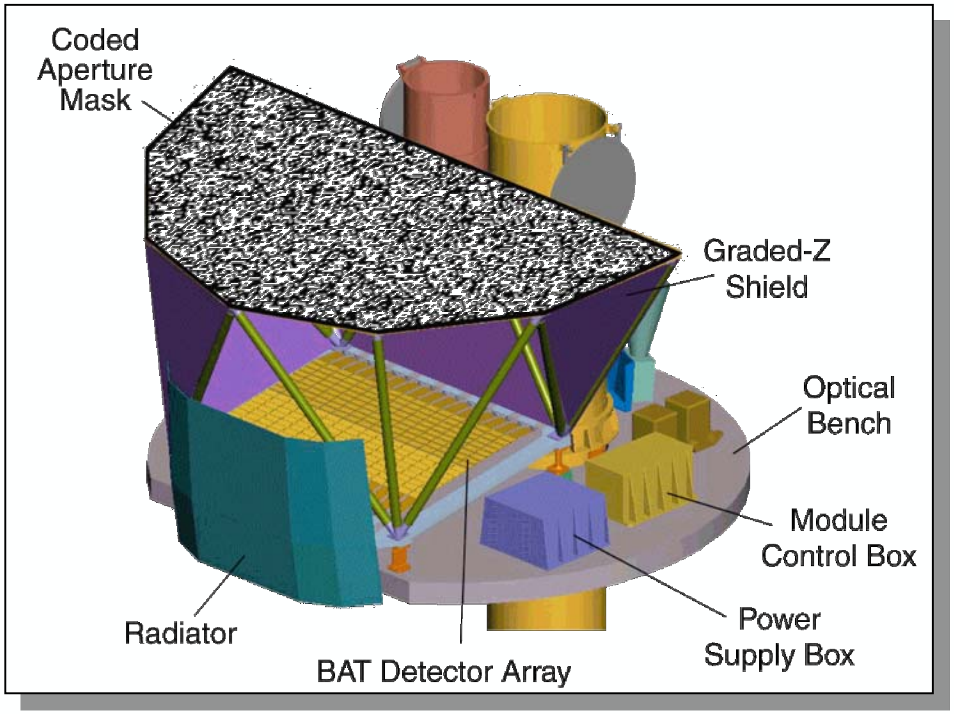
Relevance to GLAST



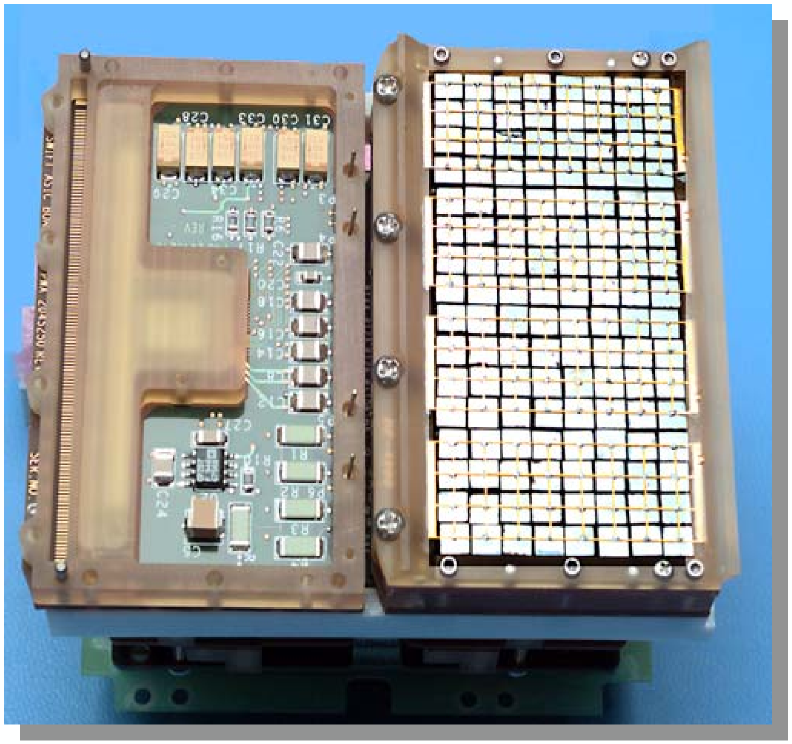
- Swift launch is September 2003
- Baseline mission duration is 2 years with orbit lifetime of ~10 years
- GLAST and Swift will likely overlap in time

BAT Instrument

- **Real time gamma ray burst positions**
  - Half coded 1.4 steradian FOV
  - 5200 cm^2 CdZnTe pixel array
  - 15 - 150 keV band
  - Based on INTEGRAL Imager design
  - 5 times more sensitive than BATSE
  - Angular resolution of 17 arcmin giving positions of 1 - 4 arcmin
  - Onboard processing to provide prompt arc-minute position to satellite and to the ground



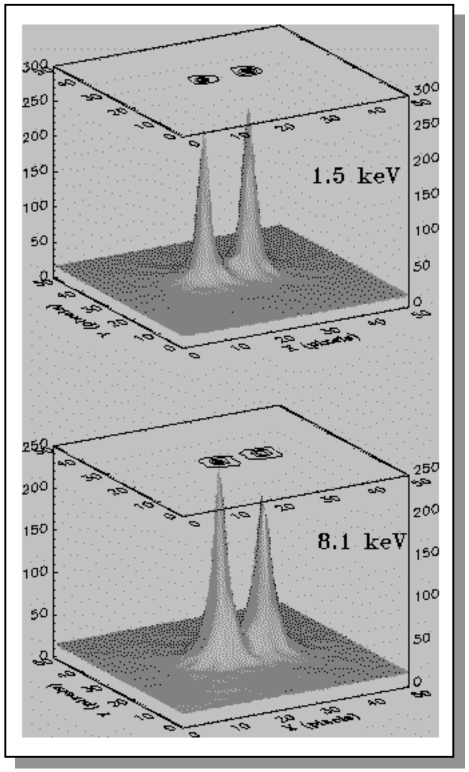
BAT Hardware



BAT Flight Mask (52,000 Lead Tiles)

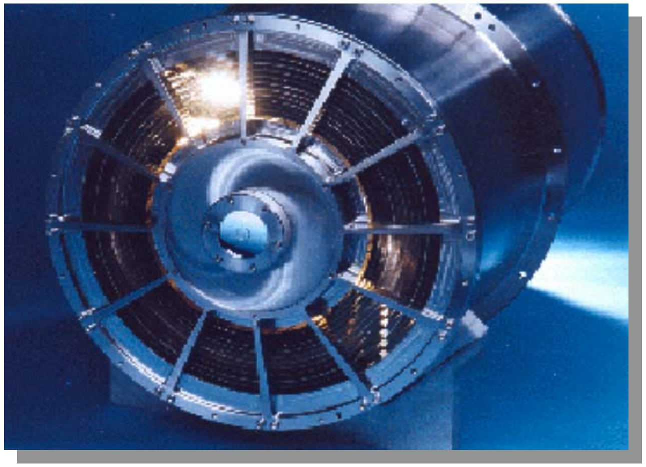
The BAT Cave

XRT Instrument

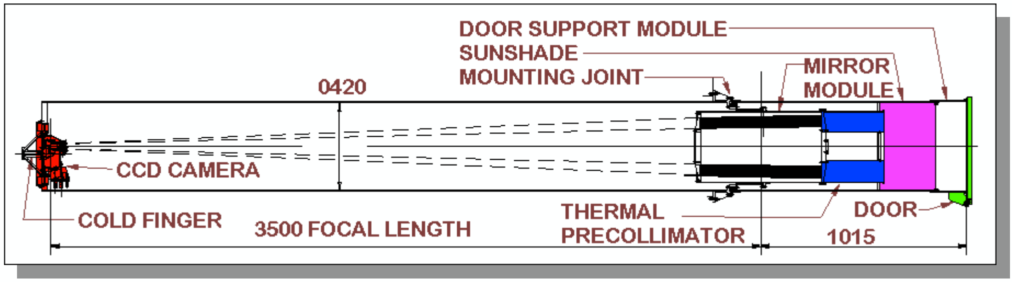


- Flight spare JET-X module
- 15 arc-second half energy width
  - sharp core will yield arcsec locations
- 3.5 m focal length
- Total effective area
  - 110 cm^2 at 1.5 keV
  - 65 cm^2 at 6 keV

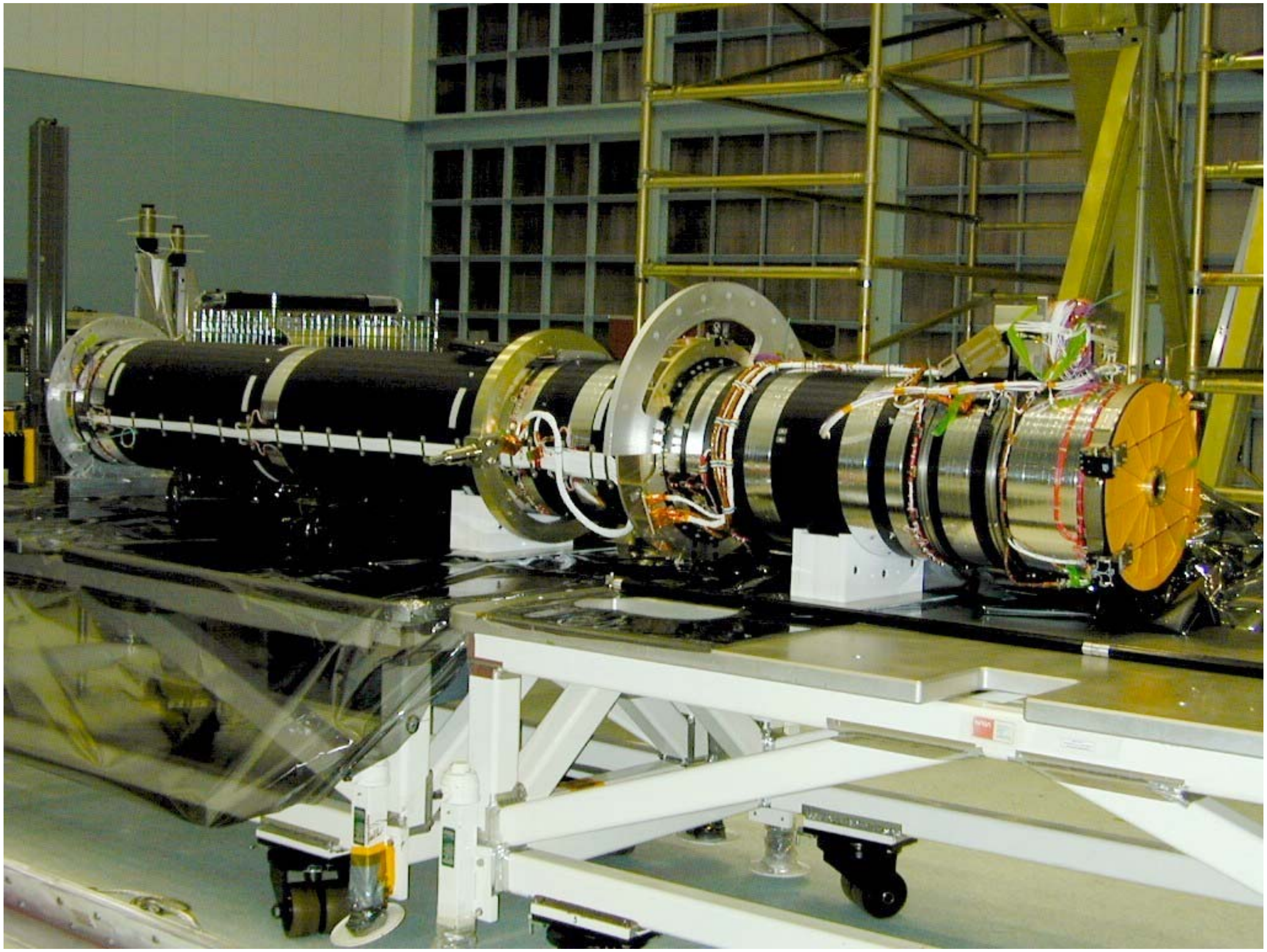
XRT Mirror Module



- **CCD array covers 0.2-10 keV band**
  - **use spare XMM chip**
  - **24 x 24 arcmin field of view**
  - **Cooled to -100 degrees C**



XRT in Goddard Clean Room

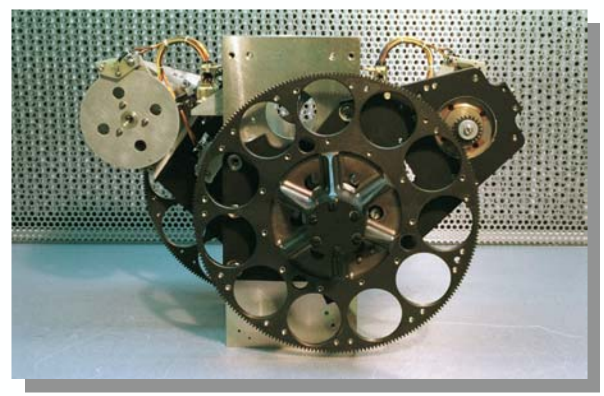


UVOT Instrument

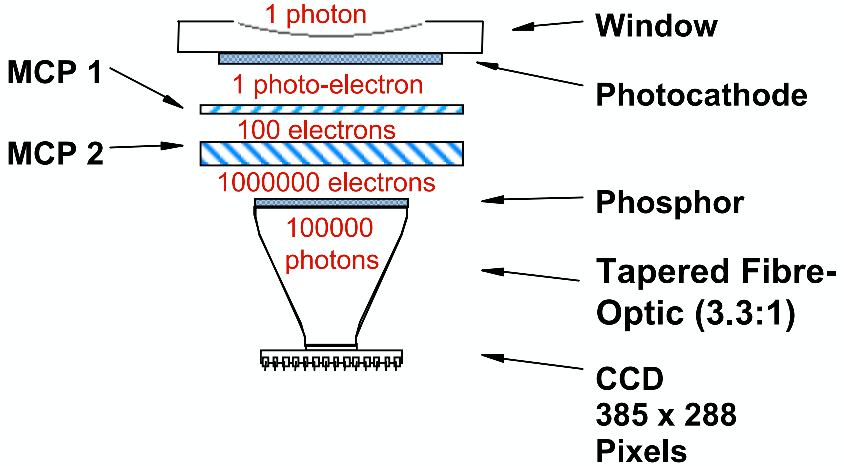
- Based on XMM OM to minimize cost and risk
  - Covers 170 nm to 650 nm
  - 30 cm Ritchey-Chretien telescope
  - 24 mag in 1000 s with 17 arcmin FOV
  - Detector is image intensified CCD array
  - Unique coverage 20-70 s after burst trigger
  - Positions to 0.3 arcseconds using onboard image registration

XMM OM

Filter Wheel



Detector schematic

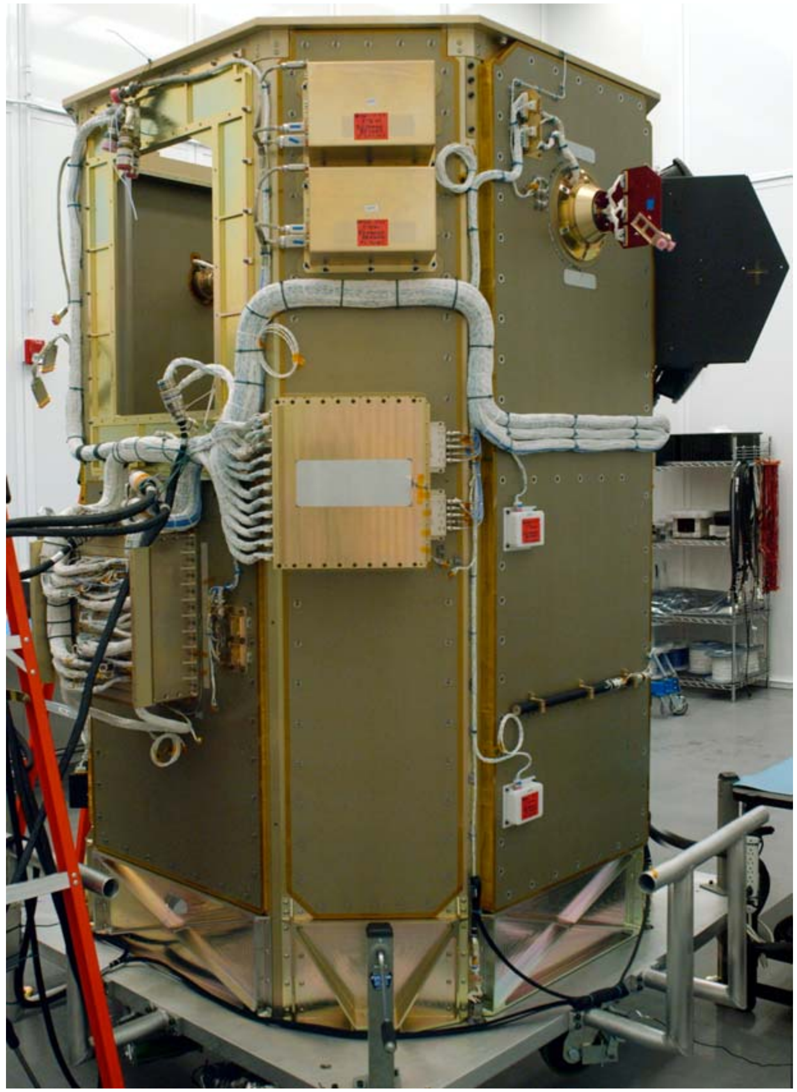


MCP 1 : 8 micron pores on 10 micron centres
MCP 2 : 10 micron pores on 12 micron centres

View of telescope

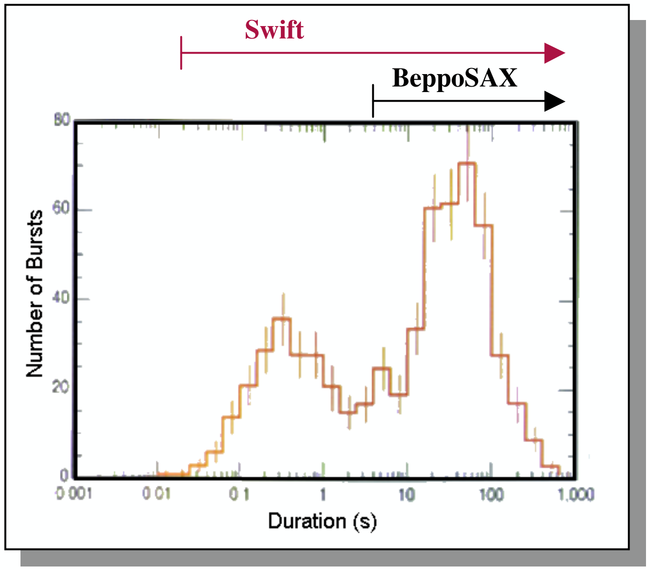
UVOT Measurement of PSF

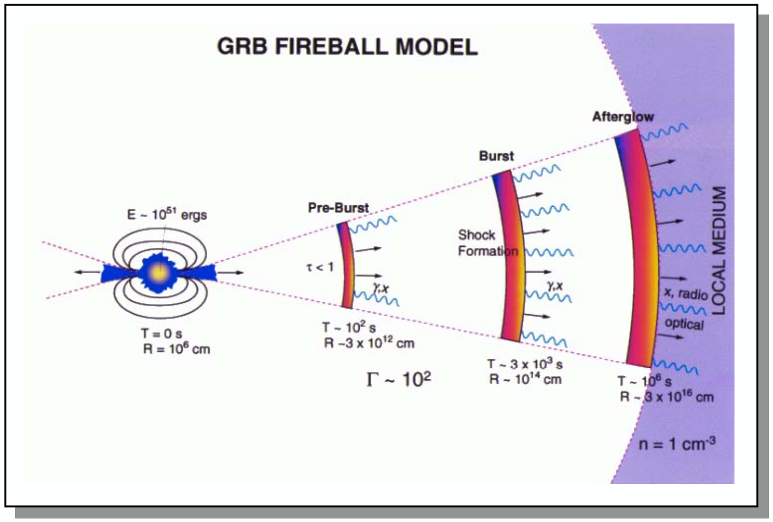
Spacecraft At Spectrum Astro



Swift GRB Capabilities

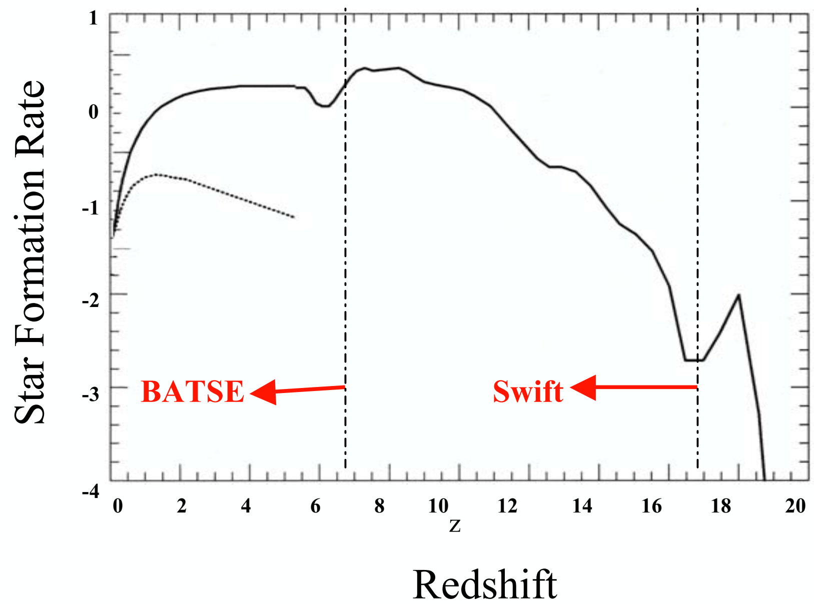
- Afterglow observations ~1 min. after GRB
- >100 GRBs per year
- Arcsec positions rapidly available
- X-ray spectroscopy in 0.2 - 10 keV band
- Sub-arcsec optical imaging
- UV/optical photometry to 24 mag
- UV/optical spectroscopy with grism
  (<17 mag)
- Redshift determinations
- Rapid data distributed via GCN
- 15-150 keV trigger
- Trigger sensitive to short & x-ray GRBs
- GRB detection with 5x BATSE sensitivity





Early Universe Studies

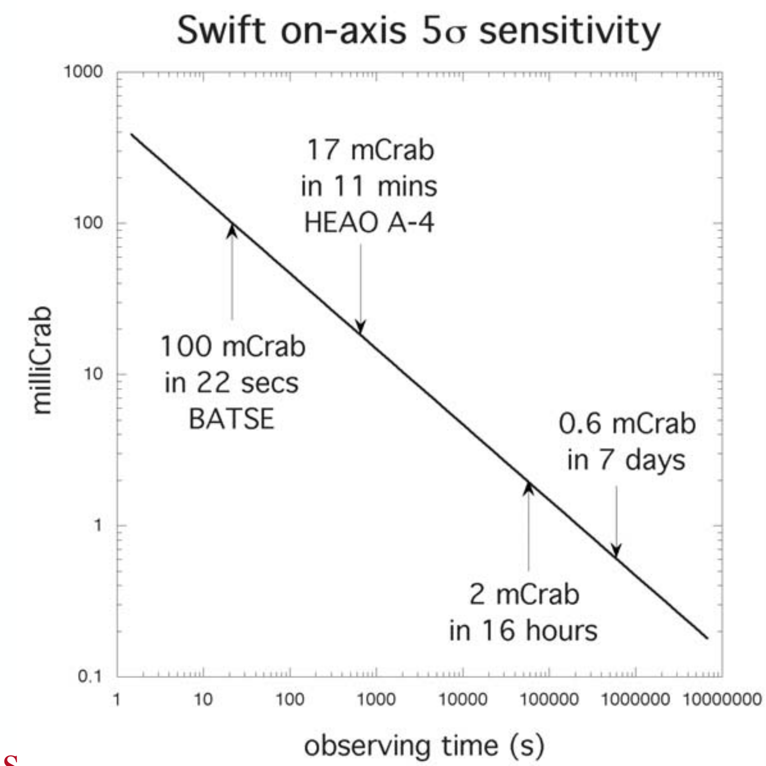
- Star formation history
- Re-ionization of IGM
- Metallicity history
- Epoch of first stars
- Dust and gas content of early galaxies

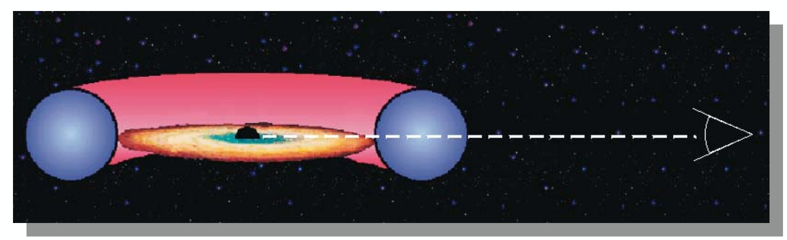


Lamb & Reichart (2000)

Swift Non-GRB Capabilities

- Hard x-ray survey of sky
  - 0.6 mCrab* sensitivity (high latitude)
  - 30 times better than HEAO-3 (1979)
  - Search for predicted class of absorbed Seyfert 2 AGN
- Monitor sky for transients
  - ~50% sky coverage on each orbit
  - ~10 mCrab sensitivity per orbit
  - 15 - 150 keV
- Response to transient detection
  - Community notification, minutes timescales
  - Observatory repointing, hour timescales





* 1 mCrab = 2×10^{-11} erg cm^{-2} s^{-1}

Swift / GLAST Joint Operations

- GLAST GRBs can be followed up by Swift
  - Few arcmin localizations of GLAST are well-suited to Swift XRT & UVOT fields-of-view
  - Unique counterparts can be found
  - Redshifts and host information will be determined
- Swift GRBs can be followed up by GLAST
  - Searches performed for high energy afterglows
  - Correlations studies of high energy signatures with low energy and afterglow properties

Swift / GLAST Joint Operations cont.

- Rapid downlink and uplink capabilities of both mission through TDRSS will enable coordinated observations
- GRB afterglow observations are optimum when communication time is minutes to ~1 hour
  - May drive requirements for rapid (or autonomous) turn-around at the MOCs
  - GCN link between missions should be adequate for communications
- An exciting possibility is to point GLAST and Swift at the same part of the sky when the orbits synch up for true simultaneous observations of prompt phase of GRBs and other transients

Swift / GLAST Joint Science Highlights

- Identification of GLAST GRB counterparts by Swift
- Joint GRB pulse search for quantum gravity signatures
- Joint studies of high redshift GRBs
  - Absorption studies
  - Environments of early stars
- Blazar campaigns
  - Flare triggers from GLAST to enable multiwavelength campaigns with Swift instruments
  - Flare detections by Swift of AGN outside of LAT scans/pointing

Recent News & Upcoming Events

- XRT & UVOT instrument delivered to Goddard this summer
- Spacecraft delivered this week
- BAT instrument scheduled for completion in February
- Guest Investigator program approved for Swift
- EPO program in high gear
- Community workshops planned for Rome GRB meeting (Sept. '02) and Nashville AAS meeting (May '03)
- Launch on for September 2003 !!

Swift GI Program

- 1999 Swift MIDEX AO did not have provisions for a GI (Phase F) program
- Swift with GRB follow-up is ideally suited for community involvement.
- Opportunities in Cycle 1
  - Correlative observations of GRBs with non-Swift instruments and observatories
  - New GRB projects using Swift data but not requiring GI-specified observatory pointings
  - Theoretical investigations that advance the mission science return in the area of GRBs
- Grants budget: $1.0M Cycle 1, $1.5M in Cycle 2
- Announced through ROSS-03 NRA in January 2003 with proposal due in June 2003